Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Lightning Instrument Package (LIP) IPHEx

Introduction

The GPM Ground Validation Lightning Instrument Package (LIP) IPHEx dataset consists of electrical field measurements of lightning and navigation data collected by the Lightning Instrument Package (LIP) flown aboard a NASA ER-2 high-altitude aircraft during the GPM Ground Validation Integrated Precipitation and Hydrology Experiment (IPHEx) held in North Carolina. The goal of IPHEx was to evaluate the accuracy of satellite precipitation measurements and use the collected data for hydrology models in the region. These data files are available in ASCII format and browse imagery in PNG format from May 1, 2014 through June 14, 2014.

Notice:
This dataset is not continuous as flights did not occur every day.

Citation

Lang, Timothy. 2020. GPM Ground Validation Lightning Instrument Package (LIP) IPHEx [indicate subset used]. Dataset available online from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi:
http://dx.doi.org/10.5067/GPMGV/IPHEX/LIP/DATA101

Keywords:

NASA, GHRC, IPHEx, GPM GV, North Carolina, CONUS, LIP, Lightning, ER-2

Campaign

The Global Precipitation Measurement mission Ground Validation (GPM GV) campaign used a variety of methods for validation of GPM satellite constellation measurements prior to and after launch of the GPM Core Satellite, which launched on February 27, 2014. The validation effort entailed numerous GPM-specific and joint-agency/international external field campaigns, using state of the art cloud and precipitation observational infrastructure

(polarimetric radars, profilers, rain gauges, disdrometers). Surface rainfall was measured by very dense rain gauge and disdrometer networks at various field campaign sites. These field campaigns accounted for the majority of the effort and resources expended by GPM GV mission. More information about the GPM GV mission is available at the PMM Ground Validation webpage.

The GPM Integrated Precipitation and Hydrology Experiment (IPHEx) was held in North Carolina during the months of April-June 2014. IPHEx seeks to characterize warm season orographic precipitation regimes, and the relationship between precipitation regimes and hydrologic processes in regions of complex terrain. The IPHEx focus includes the development, evaluation and improvement of remote-sensing precipitation algorithms in support of the GPM mission through the NASA GPM GV field campaign (IPHEX_GVFC) and the evaluation of Quantitative Precipitation Estimation (QPE) products for hydrologic forecasting and water resource applications in the Upper Tennessee, Catawba-Santee, Yadkin-Pee Dee and Savannah river basins: (IPHEX-HAP, H4SE). NOAA Hydrometeorology Testbed (HTM) has synergy with this project. More information about IPHEx is available at the IPHEx Field Campaign webpage.

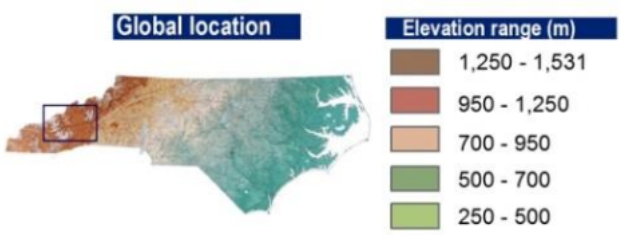

Figure 1: Region of North Carolina IPHEx campaign ground validation (image source: http://gpm-gv.gsfc.nasa.gov/Gauge/)

Instrument Description

The Lightning Instrument Package (LIP) operated on the NASA ER-2 high-altitude aircraft and consists of eight state-of-the-art digital electric field mills, a dual-tube Gerdien conductivity probe, and a distributed computer system. The field mills are mounted on the ER-2 aircraft (Figure 2) and calibrated so that one can derive the external electric field (i.e., Ex, Ey, Ez) where the aircraft is located. The field mills also provide a measurement of the electric charge (Q) on the aircraft. These data can greatly improve knowledge of the electrical structure of storms from ER-2 overflights, particularly when the ER-2 passes storms off-center or encounters complex storm geometries.

The conductivity probe is installed on either the right or left hand superpod nose cone (Figure 2). It measures the air conductivity at the aircraft flight altitude. The probe consists of a pair of Gerdien capacitor type sensors so that the contributions to the total conductivity due to positive and negative ions are obtained simultaneously throughout each flight. Storm electric currents can be derived using the electric field and air

conductivity measurements. The distributed computer system records and transmits decimated data to the ground. The system is also capable of being commanded from the ground to change various parameters.

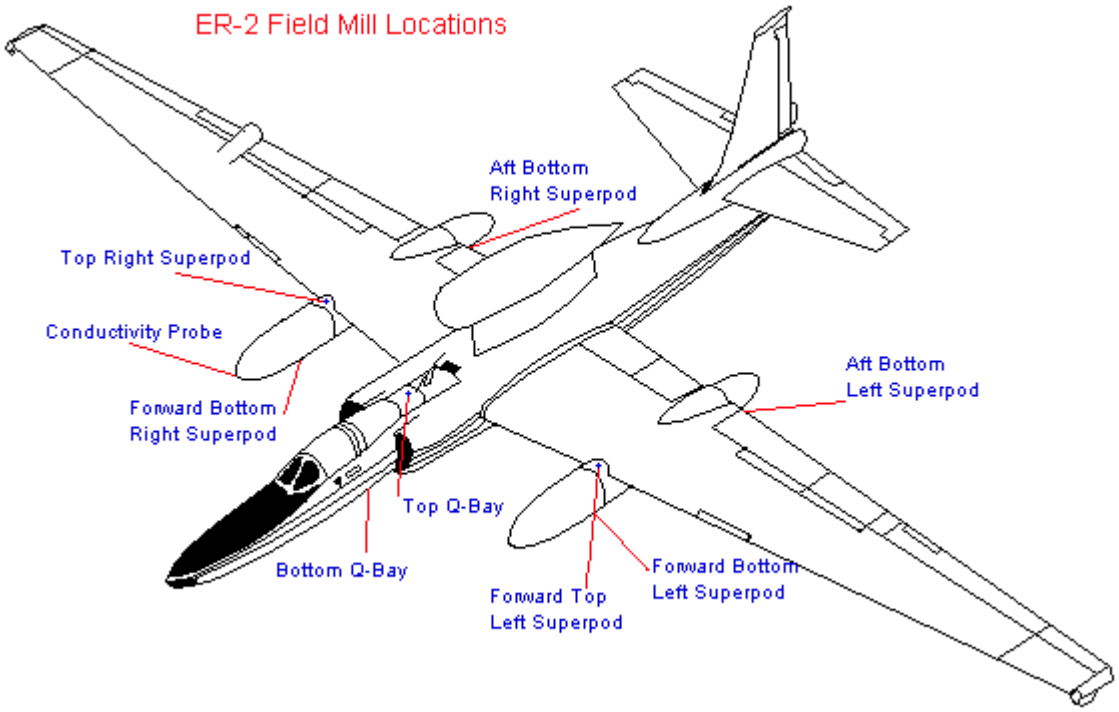

Figure 2: Locations of the eight field mills and the conductivity probe as mounted on the ER-2 aircraft.
(Image source: Richard J. Blakeslee)

Investigators

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Data Characteristics

The GPM Ground Validation LIP IPHEx dataset contains data files in ASCII format and browse imagery in PNG at a Level 1A processing level. More information about the NASA data processing levels are available on the EOSDIS Data Processing Levels webpage. Table 1 shows the characteristics of this dataset.

Table 1: Data Characteristics

Characteristic	Description
Platform	NASA Earth Resources 2 (ER-2) aircraft
Instrument	Lightning Instrument Package (LIP)
Spatial Coverage	N: 36.643, S: 26.799, E: -71.611, W: -121.853 (CONUS)
Spatial Resolution	point

Temporal Coverage	May 1, 2014 - June 14, 2014
Temporal Resolution	Daily -< Weekly
Sampling Frequency	0.02 seconds
Parameter	Atmospheric electricity
Version	1
Processing Level	1A

File Naming Convention

The GPM Ground Validation LIP IPHEx data and browse files are in the naming convention below.

Data files: iphex_lip_YYJJJ.txt
Browse files: iphex_lip_YYJJJ_##.png

Table 2: File naming convention variables

Variable	Description
YY	Two-digit year
JJJ	Three-digit day of the year
.txt	ASCII text format
##	Number image of that day
.png	Portable Network Graphic

Data Format and Parameters

The GPM Ground Validation LIP IPHEx data files are in ASCII format. There are eight fields in each data file (Table 3). The browse imagery are in PNG format and each file contains four time series plots: the three vector components of the ambient electric field data (Ex, Ey, and Ez), and the electric field due to charge on the aircraft (Eq).

Table 3: Data fields in the LIP ASCII data files

Column	Data field	Unit
1	Date string 1 (year-month-day of month) (i.e., 2017-03-21)	-
2	Date string 2 (Hour:Minute:Seconds.Milliseconds) (i.e., 18:30:00.000)	-
3,4,5	Vector components of the electric field (Ex, Ey, Ez) in the aircraft frame of reference	kV/m
7	Lat	Degrees North
8	Lon	Degrees East
9	Alt	km

Quality Assessment

Each electric field mill incorporates self-calibration capabilities that reduce the time required to obtain a full aircraft calibration (Mach and Koshak, 2007). In addition, the

electric field signals are digitized at each mill and transmitted as a digital data stream, reducing signal noise and simplifying aircraft integration (Bateman et al., 2007).

Software

No software is required to view these ASCII data files and PNG browse imagery.

Known Issues or Missing Data

This dataset is not continuous as flights did not occur every day. Missing values are set as 'NaN'.

References

Koshak, W. J., D. M. Mach, H. J. Christian, M. F. Stewart, and M. G. Bateman (2006). Retrieving storm electric fields from aircraft field mill data. Part II: Applications. J. Atmos. Oceanic Technol., 23, 1302–1322. doi: https://doi.org/10.1175/JTECH1918.1

Mach, D. M., and W. J. Koshak (2007). General matrix inversion technique for the calibration of electric field sensor arrays on aircraft platforms. J. Atmos. Oceanic Technol., 24, 1576-1587. doi: https://doi.org/10.1175/JTECH2080.1

Bateman, M. G., M. F. Stewart, R. J. Blakeslee, S. J. Podgorny, H. J. Christian, D. M. Mach, J. C. Bailey, and D. Daskar (2007). A low-noise, microprocessor-controlled, internally digitizing rotating-vane electric field mill for airborne platforms. J. Atmos. Ocean. Tech., 24, 1245–1255. doi: https://doi.org/10.1175/JTECH2039.1

Related Data

All other dataset collected as part of the IPHEx campaign are considered related and can be located by searching the term "IPHEx" in the GHRC HyDRO2.0 search tool. Listed below are datasets from other field campaigns and studies that used the LIP instrument:

GRIP Lightning Instrument Package (LIP)
(http://dx.doi.org/10.5067/GRIP/LIP/DATA201)

TCSP ER-2 Lightning Instrument Package (LIP)
(http://dx.doi.org/10.5067/TCSP/LIP/DATA101)

CAMEX-3 Lightning Instrument Package (LIP) (http://dx.doi.org/10.5067/CAMEX-3/LIP/DATA001)

GOES-R PLT Lightning Instrument Package (LIP)
(http://dx.doi.org/10.5067/GOESRPLT/LIP/DATA101)

TRMM-LBA Lightning Instrument Package (LIP)
(http://dx.doi.org/10.5067/LIS/LIP/DATA101)

CAMEX-4 ER-2 Lightning Instrument Package (LIP) (http://dx.doi.org/10.5067/CAMEX-4/LIP/DATA002)

CAMEX-4 DC-8 Lightning Instrument Package (LIP) (http://dx.doi.org/10.5067/CAMEX-4/LIP/DATA001)

Contact Information

To order these data or for further information, please contact:

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